With the exception of an enumeration of the flora of the little island of Giannutri, off the coast of Tuscany, the number of the *Nuovo Giornale Botanico Italiano* for April is chiefly occupied with a report of the meetings of the Italian Botanical Society, held sometimes at Florence, sometimes at Rome. The papers here reported are mostly of interest to Italian botanists: those of more general importance being chiefly by Prof. Arcangeli, who continues his researches on the interesting points of structure in the anatomy of *Euryale*, and other members of the water-lily family.

*Memoirs of the St. Petersburg Society of Naturalists*, Zoology and Physiology, vol. xix. No. 2.—The article on the fauna of the White Sea, by V. M. Shimkevitch, contains two separate monographs. One of them deals with the *Balanoglossus*, and is a detailed anatomical research into its structure, thus making a most valuable addition to the work of Kovalevsky, Agassiz, Metchnikoff, Spengel, Balfour, and Bateson. The author's conclusions are, that the *Balanoglossus* occupies an intermediate position between the worms and the *Chordata*. It has originated from a trochozoon which acquired some features in common with worms, as well as some features distinctive of the *Chordata*. The other monograph deals with the *Enteropsis dubius*, a new parasitic species closely akin to Aurivillius's *Enteropsis sphinx* (*Krustaceer hos arktiska Tunicater*). The morphology and embryology of this new Copepod are dealt with, and they are followed by general remarks about the history of development of parasitic *Copepods*. Both papers are well illustrated with plates.—A paper by N. N. Polejaeff deals rather too shortly with the following topics: on the filaments which are found in the *Hircinidæ* sponges; on spermatogenesis of the *Porifera;* on the anatomy of *Chalinidæ;* on the *Luffaria;* and on the new genus of *Porifera*, the *Korotnewia desiderata* (with plates).—The appendix to the same volume contains a detailed experimental inquiry, by A. Gendre, into the causes of death in animals when the excretory functions of the skin are artificially stopped.

## SOCIETIES AND ACADEMIES.

### London.

**Royal Society**, May 8.—"On the Heating Effects of Electric Currents. No. IV." By William Henry Preece, F.R.S.

The following table gives the fusing constants and fusing temperatures for all the metals in general use when bare and exposed in still air:—

| | Fusing constant. (*a*) | Fusing temperature. ° C. |
|---|---|---|
| Copper ... ... ... ... | 2530 ... | 1054 |
| Silver[1] ... ... ... ... | 1900 ... | 954 |
| Aluminium ... ... ... | 1873 ... | 650 |
| German Silver ... ... ... | 1292 ... | 1200 |
| Platinum ... ... ... | 1277 ... | 1775 |
| Platinoid ... ... ... | 1173 ... | 1300 |
| Iron ... ... ... ... | 774·4 ... | 1600 |
| Tin ... ... ... ... | 405·5 .. | 226 |
| Lead ... ... ... ... | 340·6 ... | 335 |
| Alloy (lead 2 parts, tin 1 part) | 325·5 ... | 180 |

The table means that if we take, for example, a uniform copper wire of 1 cm. diameter, a current of 2530 amperes will raise it to 1054° C., and therefore fuse it; and if we take any conductor of copper of similar form, but of different diameter ($d$), the fusing current (C) is

$$C = 2530 d^{\frac{3}{2}}.$$

The fusing current of any other material is obtained from the equation

$$C = a d^{\frac{3}{2}}.$$

It seemed natural that these constants, marking such a distinct and well-defined fiducial point, should also enable us to obtain the currents that would raise the wire to any other temperature.

It is shown that if we determine C for any temperature, then, since $\theta = \kappa C^2$, $\theta$ being the rise of temperature, the current $C'$ producing any other temperature $\theta'$ is obtained by means of the equation

$$C' = C \sqrt{\frac{\theta'}{\theta}}.$$

Now, for copper of 1 cm. diameter C = 2530 for 1054°. Thus, if we want to find the current that will raise such a conductor to 13°, we have

$$C' = 2530 \sqrt{\frac{13}{1054}} = 281 \text{ amperes,}$$

if the surface be equivalent to the normal surface at white heat.

The coefficient which converts this normal surface emissivity to that of the surface of ordinary wires at low temperatures by taking the normal surface as unity, is as follows:—

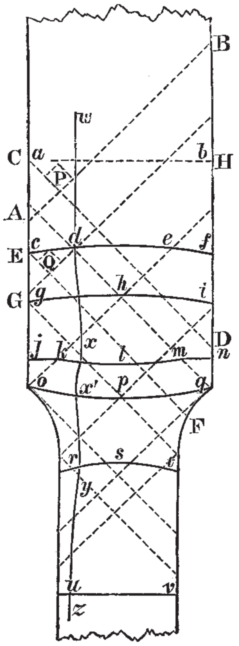
| | Surface coefficient. |
|---|---|
| Bright and polished copper ... ... | 0·5 |
| Copper, dirty, oxidized, or blacked with shellac varnish ... ... | 0·6 |
| Copper, well coated with lamp-black | 1·0 |

Thus, the current (C) producing 1054° ($\theta$) in a bare bright copper cylinder of 1 cm. diameter is 0·5 × 2530 amperes, and that which would produce a temperature of 10° C. is

$$0·5 \times 2530 \sqrt{\frac{10}{1054}} = 123·2 \text{ amperes.}$$

Thus, if we know the current producing any fixed temperature in any cylindrical conductor, we can readily calculate the current required for any other temperature.

**Physical Society**, May 2.—Prof. W. E. Ayrton, President, in the chair.—Mr. C. A. Carus-Wilson read a paper on the distribution of flow in a strained elastic solid. The author pointed out that when a bar is subjected to tensile stress the elements of the bar are distorted by the resulting shearing stresses which attain maxima in planes at 45° to the axis. If the bar be supposed to be divided into elements such as P or Q (see Fig.), then if the shearing strains are equal in the two directions parallel to the sides of the elements, the bottom points of the strained elements will be directly below their top corners, whereas if the strains be different in the two directions there will be a displacement to one side or the other depending on which side the greater strain occurs. Since each inclined section is subject to the same total shearing force, the shearing strain along any section such as EF may be taken as inversely proportional to the length of the line EF, the bar being supposed of uniform thickness. From these considerations it may be seen that an element P will be subject to equal strains, for AB = CD, hence the lower point of P will remain vertically below its upper point. In this region, therefore, a horizontal straight line drawn



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[1] G. Roux, *L'Électricien*, December 14, 1889.

on the unstrained bar will remain horizontal and straight on the strained bar. An element at Q, however, will be subjected to unequal strains, for EF is $<$ GH, hence the lower points of the elements will be displaced towards the axis. This displacement will increase as the distance beyond *d* and *e* from the axis increases, and an originally horizontal line will become curved at the ends *cd* and *ef*, whilst *de* will remain straight. In a similar way it was shown that horizontal lines should assume the shapes indicated at *ghi*, *jklmn*, *opq*, *rst*, and *uv*, in their respective positions, whilst vertical lines should become pinched inwards above and below the shoulder as shown by the curve *wxx'yz*. To test whether the reasoning, by which the above conclusions were arrived at, was satisfactory, a copper bar was carefully prepared, ruled, and subjected to permanent strain. The curvatures of the various lines clearly show the characteristics predicted by theory. Prof. Perry inquired whether it was correct to assume the stress uniform over the plane sections inclined at 45° to the axis. He also said that the general character of the flow somewhat resembled that of a viscous fluid passing from a wide to a narrower channel. Prof. Herschel thought Mr. Carus-Wilson justified in assuming the stress uniform over the diagonal sections; the latter said he only made the assumption as a provisional hypothesis, but the results of his experiment agreed so closely with his theoretical deductions that he thought the hypothesis correct.—Mr. C. V. Boys made two communications, (1) on photographs of rapidly moving objects, and (2) on the oscillating electric spark. A collection of apparatus by which he had been able to photograph drops of water in their various stages of formation was exhibited. It consisted of a lantern and lenses by which a trough in which the drops were formed could be strongly illuminated, combined with a camera and revolving disk with one perforation. By this means exposures of about 1/600 of a second could be made about 20 times a second. The slide of the camera was about 3 feet long, and could be moved across the field by hand so as to take the consecutive impressions on different parts of the plate. The resulting photographs show with remarkable clearness the formation, breaking away, the oscillations of the drops, and their rebounding in the liquid into which they fall. By cutting the photographs into strips, each strip representing a single exposure, and mounting them on a disk, Mr. Boys had arranged a kind of thaumatrope which represented the phenomena in a very realistic manner. He also exhibited photographs of small water fountains broken up into drops by musical sounds, which he had taken by the electric spark without the aid of lenses. The shadows of the drops were sharply defined even when magnified considerably, and the various stages of transition from the liquid column to the detached particles were well shown. Finding it possible to obtain such good results from a simple spark, it occurred to him that he might get a succession of photographs from the intermittent light of an oscillating spark, and in this he was fairly successful. An apparatus devised to show the oscillatory character of a discharge was next exhibited in operation. It consisted of a disk carrying six lenses arranged in two sets of three. The members of each set were at different distances from the axis so that the images of the spark on the screen do not coincide. The disk can be revolved at a high speed, and the successive sparks are seen as bright patches on the screen. By this apparatus a single discharge can be examined, whereas with Dr. Lodge's apparatus it is desirable to have a fairly rapid succession of sparks. Photographs of an oscillatory discharge taken with the apparatus were exhibited, and these show that the duration of the illumination is a considerable fraction of a complete period. Lord Rayleigh said he was greatly interested by Mr. Boys's apparatus. He (Lord Rayleigh) had photographed water fountains both when broken up, and when made to coalesce under electrical influence, but it had never occurred to him that it would be possible to get enough light or sufficient sharpness from a single spark. Mr. Boys's success he believed to be owing to the fact of his using no lenses, which would absorb the ultra-violet rays. He also thought the method might be developed so as to give shaded pictures instead of mere representations in black and white. Mr. Gregory asked Mr. Boys if he had tried to get greater potentials for his oscillatory discharges by using Dr. Lodge's "impulsive rush" arrangement. Mr. Trotter inquired whether the single sparks used to photograph the water fountains were as large as those required to show oscillations. Mr. Boys said he had not tried Dr. Lodge's "impulsive rush" arrangement because of the enormous capacity of the condensers required. The sparks used to photograph the broken up fountain were very small, being only about $\frac{1}{4}$ inch long, and from a few jars. Prof. Perry asked Lord Rayleigh whether it would be possible to compare the shapes of the water drops shown in the photographs with the shapes of the liquid surfaces of revolution given by Sir William Thomson at the Royal Institution some years ago, or whether the changes of shape were too rapid to permit of the surface tension being all important. Mr. Boys thought the motions of the drops would be too rapid, and that inertia would play an important part. Lord Rayleigh pointed out that by forming a drop slow enough the effect of inertia might be made negligible until such time as the unstable state was reached; after that, however, inertia must have considerable influence on the shape.

**Geological Society**, April 30.—Dr. A. Geikie, F.R.S., President, in the chair.—The following communications were read:—On certain physical peculiarities exhibited by the so-called "raised beaches" of Hope's Nose and the Thatcher Rock, Devon, by D. Pidgeon.—The Devonian rocks of South Devon, by W. A. E. Ussher, of H.M. Geological Survey. This paper is the result of work done in continuation of the labours of the late Mr. Champernowne, and refers particularly to the area north of the Dart and east of Dartmoor. Owing to the complicated stratigraphy of the region, we have to fall back upon such information as can be procured of the general types of Upper, Middle, and Lower Devonian faunas; for though the lithological constituents of these three divisions are broadly distinguishable, there are no definite lithological boundaries between them. The Lower Devonian is mainly distinguished by the occurrence of sandstone and grit, but the upper beds are shales passing into the Middle Devonian slates. The Middle Devonian consists of limestones, and shaly limestones upon slates, the latter representing the Calceolen-Schiefer, and containing *Spinifer speciosus*. *Stringocephalus* is found here and there in the middle Devonian Limestones. The upper part of the middle Devonian Limestones (with Lummaton fauna) passes into the *Cuboides* beds of the Upper Devonian. The Upper Devonian contains thin-bedded limestones, often concretionary, with chocolate-red and pale greenish slates and mudstones. These beds correspond to the Goniatiten-Schichten, Kramenzelstein and Knollenkalk of Germany, and to the Cypridinen-Schiefer. In the Upper and Middle Devonian rocks we find a local prevalence of schalstein and tuffs, breaking up the limestones. The slate and sandstone type of Upper Devonian in North Devon appears to give place southward to a purely slate type, possibly accompanied by overlap of the Culm measures. The author groups the South Devon rocks under the following heads:—

| | | |
|---|---|---|
| Upper. | 1. | Cypridinen-Schiefer. |
| | 2. | Goniatite-limestones and slates. |
| | 3. | Massive Limestones. |
| Middle. | 4. | Ashprington Volcanic Series. |
| | 4. | Middle Devonian Limestones. |
| | 5. | Eifelian slates and shaly limestone. |
| Lower. | 6. | Slates and sandstones, generally red. |
| | 7. | Slates with hard grits. |

After discussing the relationship of the Lincombe and Warberry beds and the New Cut Homalonotus beds, the author notes the discovery of *Pleurodictyum* by Mr. Whidborne in the railway cutting at Saltern Cove. He proves the Lower Devonian age of the Cockington beds and their correlation with the Torquay Lower Devonian by the discovery of fossils. He considers it probable, though not certain, that the main mass of Meadfoot beds is below the Lincombe, Warberry, and Cockington sandstones. The distribution of the Middle Devonian Limestones is described. *Stringocephalus* is found in limestones containing *Rhynchonella cuboides*. The upper parts of the limestone-masses (East Ogwell, Kingskerswell, Barton, Ilsham, &c.) may be Upper Devonian. The massive limestones may terminate abruptly or pass laterally into shales, and the whole mass of the limestones seems to be replaced by slates between the Yealmpton and Totnes areas. The commencement of the phase of volcanic activity which caused the accumulation of the Ashprington series is shown to coincide with the latest stage of Eifelian deposition, and the Ashprington series may represent continuous or intermittent vulcanicity up to a late stage in the Upper Devonian. North of Stoke Gabriel a mass of limestone seems to have been formed contemporaneously with the volcanic material on the immediate borders of which it occurs. Elsewhere the limestones are interrupted by local influxes of volcanic material. The occurrence of other local developments of Middle and Upper Devonian volcanic rocks is described. The relationship of the Middle and Upper Devonian deposits varies. In some cases Upper Devonian shales may have been deposited against Middle Devonian limestones; in others there is a continuous development of limestone, the Middle Devonian limestones being succeeded by *Cuboides* beds, *Goniatite* limestones, and Knollenkalk. The local variations of these are described, and fossil lists are given. The Knollenkalk is shown to pass under *Entomis* bearing beds ("Cypridinen-Schiefer"), which are described, though a detailed account of their relationship to the Culm-measures is reserved for a future occasion. After the reading of this paper, some remarks were offered by the President, Prof. T. Rupert Jones, Prof. Hughes, and the author.

### PARIS.

**Academy of Sciences**, May 12.—M. Hermite in the chair.—New lunar photographs by the Brothers Henry, of Paris Observatory, by M. Mouchez (see Our Astronomical Column).—On volume iii. of the "Annales de l'Observatoire de Nice," by M. Faye.—Experiments on the deformations undergone by the solid envelope of a fluid spheroid submitted to the effects of contraction; possible applications to dislocations of the terrestrial globe, by M. Daubrée. In order to obtain the necessary oblateness, spherical balloons of vulcanized caoutchouc, having disks of the same material affixed at the extremities of a diameter, were used. The disks gradually increased in diameter, so that the thickness gradually decreased from the poles in each hemisphere, and unequal pressure was exercised on the liquid contained in the balloon. The oblateness has been determined of various liquid spheroids, and the conditions of production of ridges and fissures similar to those exhibited in the earth's crust.—On the retardation of foliation in Provence during the spring of 1890, by M. G. de Saporta. The low temperature and the abnormal humidity having exercised a very sensible influence during the spring of this year on vegetation in the middle of France, the author has investigated the state of foliation at the beginning of May in a locality situated at Saint-Zacharie (Var), in the high valley of Huveaune, at an altitude of about 200 metres.—On an hydraulic instrument with a new model of turbine for the continued utilization of the power of rivers, by M. Paul Decœur.—The difference between the surface of the earth taken as fluid and that of an ellipsoid of revolution having the same axis, by M. O. Callandreau. It is shown that in the case of a supposed fluid earth the maximum depression for latitude 45° is 9·1 metres, which agrees with the value given by M. Helmert in his "Géodésie supérieure."—On surfaces possessing a train of geodetic conjugates, by M. C. Guichard.—On some particular cases of visibility of interference fringes, by MM. J. Macé de Lépinay and Ch. Fabry.—On undulatory transverse magnetization, by M. C. Decharme It appears from some experiments given that a continuous electric current traversing the length of a tempered cylinder of steel may become undulatory on account of the resistance which the molecular actions of the magnetic medium oppose to it.—A note by M. A. Witz describes a method of exploration of magnetic fields by tubes of rarefied gases.—On the double chlorides of iridium and phosphorus, by M. G. Geisenheimer. By heating in a sealed tube at 300° C. 1 gram of iridium hydrate with 10 grams of $PCl_3$ and 15 grams of $PCl_5$, and reheating the yellow crystalline mass obtained with $POCl_3$ to 250°, a body possessing the empirical formula $Ir_2P_3Cl_{15}$ is formed in fine clear yellow crystals. By appropriate treatment several other double chlorides are obtained therefrom. An acid corresponding to the body $Ir_2P_3Cl_{15}$ is the product obtained on evaporating an aqueous solution of the latter as far as possible. The analyses of the salts of this acid indicate that the formula for the double chloride above should be written $2Ir_2Cl_3$, $3PCl_3$, $3PCl_5$.—A note on a characteristic reaction of hydrogen dioxide, by M. G. Denigès. A 10 per cent. solution of ammonium molybdate in water added to its own volume of concentrated sulphuric acid gives with a few drops of hydrogen dioxide an intense yellow coloration.—On the existence of microlithic peridote in the andesites and labradorites of the ridge of the Puys, by M. A. Michel Lévy.—On the contact phenomena of elæolithic syenite at Pouzac (Hautes-Pyrénées), and on the transformation into *dipyre* of the felspar of the ophitic rock in the same bed, by M. A. Lacroix.—On the metamorphic rocks of Pouzac, by M. Ch. L. Frossard. These rocks, occupying a space of 1250 m. by 300 m., extending from the railway near Monloo, appear to have been principally modified by the syenite. The ophite of Palassou has hardly acted upon the surrounding rocks. The rocks of which the modifications are attributed by the author to the action of the syenite are in the state of a fragmentary breccia and are without trace of fossils or indications of stratification. They may be classed as—siliceous, hard compact argillaceous, amphibole, talcose, chloritic, limestone, and dolomite rocks.—On the organisms of nitrification, by M. S. Winogradsky. The author has succeeded in isolating the nitrifying microbe, and has found that neither its rate of multiplication nor its vigour of action is diminished by cultivation in a mineral solution quite devoid of organic carbon. The colourless microbe of nitrification is thus capable of a complete synthesis of its substance from carbonic acid and ammonia. This fact is in direct contradiction with the fundamental doctrine of physiology that a complete synthesis of organic matter only occurs in chlorophyll-bearing plants, under the action of luminous rays.

## BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Elementary Statics, new edition: Rev. J. B. Lock (Macmillan).—Dynamics for Beginners, 3rd edition: Rev. J. B. Lock (Macmillan).—Capital and Interest: E. V. Böhm-Bawerk; translated by W. Smart (Macmillan).—First Lessons in Political Economy: F. A. Walker (Macmillan).—Sketches of British Sporting Fishes: J. Watson (Chapman and Hall).—Yachting Guide and Tide Tables, 1890: A. Thomson (Pall Mall).—A Guide to the Literature of Sugar: H. Ling Roth (K. Paul).—Nautical Surveying: Vice-Admiral Shortland (Macmillan).—La Géographie Zoologique: Dr. E. L. Troussart (Paris, J. B. Baillière).—American Economic Entomology, Part 1, The More Important Writings of B. D. Walsh (Washington).—Picturesque Wales: G. Turner (Adams)—Practical Chemistry for Medical Students: S. Rideal (Lewis).—Catalogue of the Birds in the Provincial Museum, North-West Provinces, and Oudh, Lucknow (Allahabad).—Masken von Neu Guinea und dem Bismarck Archipel: Dr. A. B. Meyer (Dresden, Stengel and Markert).—Anoa Depressicornis (H. Smith): Dr. K. M. Heller (Berlin, Friedländer).—Abhandlungen und Berichte des Königlichen Zoologischen und Anthropologisch-Ethnographischen Museums zu Dresden, 1888-89: Dr. A. B. Meyer (Berlin, Friedländer).—Harpur Euclid, Books 5, 6, 11: E. M. Langley and W. S. Phillips (Rivingtons).—On Aphasia, or Loss of Speech, 2nd edition: Dr. F. Bateman (Churchill).

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